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SEASON OF BURNING AFFECTS FOLLOW-UP CHEMICAL CONTROL OF SPROUTING CHAMISE

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Brush commonly is removed from selected small areas by broadcast burning in central and northern California. This kind of burning within extensive brushfields is best done before or after the summer-fall fire season under conditions that prevent serious escape of the fire and at times that fit well into the yearly work program. To learn how season of burning affects establishment of grass and chemical control of brush regrowth on the cleared areas, we burned chamise-chaparral at different times of year as part of a brush conversion demonstration on the Mendocino National Forest.

A major objective was to determine how techniques that had been developed for killing chamise sprouts and seedlings on summer burns must be modified to fit growth of chamise on areas burned at other seasons. The recommended practice on summer burns was to sow grass in the fall and broadcast spray the chamise with hormone-type chemicals the next spring after sprouts were well developed and growing vigorously. In the tests, modifications of this practice were used in areas burned in early spring, late spring, summer, and late fall.

THE EXPERIMENT

The brush burning tests were made on the south rim of Grindstone Canyon where a wide strip of grassland was being established to facilitate fire control, improve game habitat, and increase livestock range. The brush type was a continuous expanse of dense, mature chaparral dominated by chamise (Adenostoma fasciculatum). Topography was mountainous with steep slopes, except for the ridge and sloping benchland, where brush was being converted to grass.

The area was at 2,500 feet elevation in a locality with average yearly precipitation of about 25 inches. Soil was mostly Los Gatos stony loam, 2 feet or more deep, with related soils on the benchland. Slope gradient mainly was between 20 and 40 percent. Tractor-drawn equipment could be used on almost all of the land. It was a favorable site for conversion of a chaparral type to grass.

The study area was divided into 17 plots 3 to 16 acres in size (fig. 1). On all but three plots the brush was prepared for burning by crushing it in place with a bulldozer so that it could be burned cleanly and safely under a wide range in weather conditions; the brush was smashed in October 1956, on plots 3 to 6; in March 1957, on plots 1, 2, 10, 12, 14 and 17; and on other plots in June 1957. On the three plots--9, 11, and 16--the brush was broken down after it had been burned.

Two or more plots were burned at each season. The plots were intensively ignited to obtain hot fires.

Plot 6, burned in October 1956, was sown that fall using a small grain drill. The remaining plots, burned in 1957, were sown with a heavy duty rangeland drill in October 1957.

The October 1956 plot was sprayed in June 1957 with a 20-foot boom mounted on a small tracklayer tractor. A low volatile ester of 2,4-D was applied at a rate of 2.6 pounds acid equivalent per acre in 13 gallons of emulsion containing 2.5 percent diesel oil. Part of the plots burned in April 1957 were sprayed that same year in July. On parts of some plots where live oak and poison oak were abundant, half of the 2,4-D was replaced with 2,4,5-T in both June and in July.

In June 1958 all of the area was sprayed except parts of plots 1 and 2 where there were few living chamise sprouts and parts of plots 14 and 15 where the soil was too wet for the tractor to operate. The latter spots were omitted from the samples. In 1958 low volatile esters of 2,4-D were used at 3 pounds acid equivalent per acre in 20 gallons of emulsion applied with a turbine blower mounted on a tractor drawn trailer. Distribution was less uniform than with the boom used in 1957.

In August 1957 the brush plants were counted on ten 1/100-acre belt transects in plots 2 and 6. A record was made of the plants killed by fire, fully or partially topkilled by the spray, and missed by the spray. In August 1958 the brush plants were counted and classified as to degree of kill on four 1/100-acre belt transects in each of the 17 plots. Observations of brush plant survival were made periodically through the period of study.

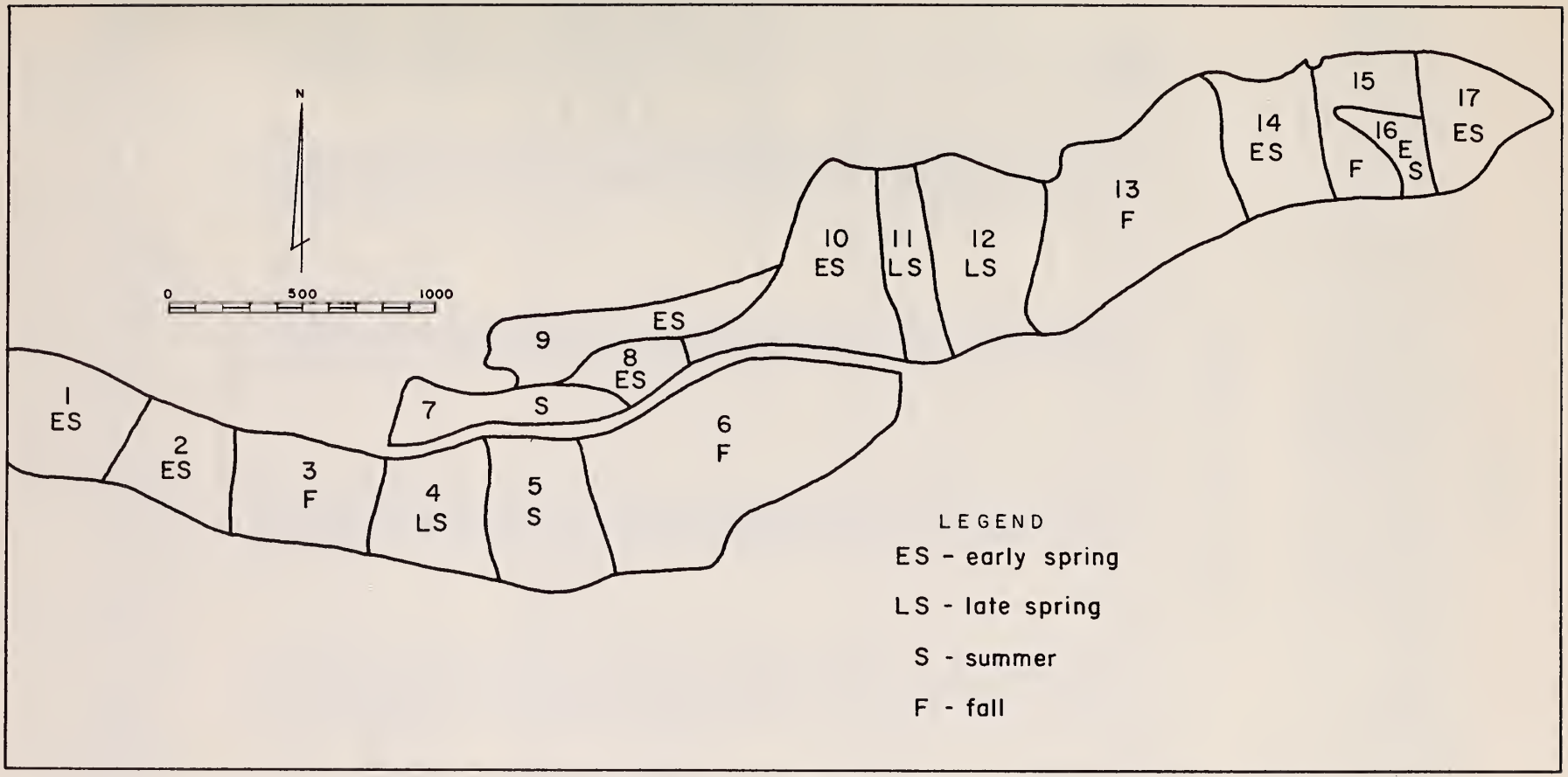

Figure 1.--Season-of-burning plots at Grindstone Canyon, Mendocino National Forest.

RESULTS

Browsing by deer greatly affected growth and survival of the chamise plants and masked some of the effects of season of burning. The combination of broadcast chemical spraying and deer browsing appeared, by 1958, to be giving adequate control of chamise regrowth on most of the plots regardless of the date of burning. But season of burning did affect timing of the spraying and its effectiveness.

EARLY-SPRING BURNING

On 8 plots burned April 4 and 5, 1957, when new twig growth was just starting, mortality during the first year ranged from 34 to 96 percent (table 1), and averaged 64 percent dead by 1958 (fig. 2). Of the dead plants about 33 percent were killed by burning and the remaining 31 percent died from other causes.

On plots 1 and 2, which had the highest mortality, most of the plants were killed by extremely heavy deer browsing. Deer kept the sprouts grazed back almost to the crown during all of the summer and fall. Percent mortality probably was higher than table 1 records because many dead plants were uprooted by the drill in October 1957 and were not counted in 1958. Spraying of these two plots in July 1957 was wasted effort.

On the other six plots, moderate to heavy browsing did not kill many chamise plants the first year. But browsing and the 1957 spraying kept the plants on 5 of these plots to a size that could be adequately covered by broadcast spray in 1958. However, on plot 17, which was not sprayed in 1957, a tall growth of yerba santa (Eriodycton californica) prevented good coverage of the chamise plants by the turbine blower spray application in 1958. On this plot the kill was not satisfactory: a total of 800 chamise plants per acre were only partially topkilled or were resprouting in August 1958. Plot 17 needed another broadcast spraying in 1959.

On the other seven plots burned in early spring, control of chamise sprouts appeared satisfactory in August 1958. An average of 114 plants per acre was still alive; but vigor was poor, the plants were being browsed by deer, and continued dying was expected. Any remaining plants could be killed later by hand spraying. Seedlings, which occurred in variable numbers on the plots each year, had been killed by the broadcast spraying.

LATE-SPRING BURNING

On the three plots burned in late spring, the first-year mortality ranged from 38 to 71 percent (table 2) and averaged 57 percent by 1958. Most of the dying appeared to be caused by the hot fires, although moderate to heavy browsing of the sprouts may have caused some mortality. The plants did not sprout profusely. The date of burning, June 4 and 5, was later than for the usual

late-spring burning; the test had to be postponed because of rains in May. The vegetation was past the most rapid growth period although some flowers still remained on the chamise plants. The surface soil was still moist.

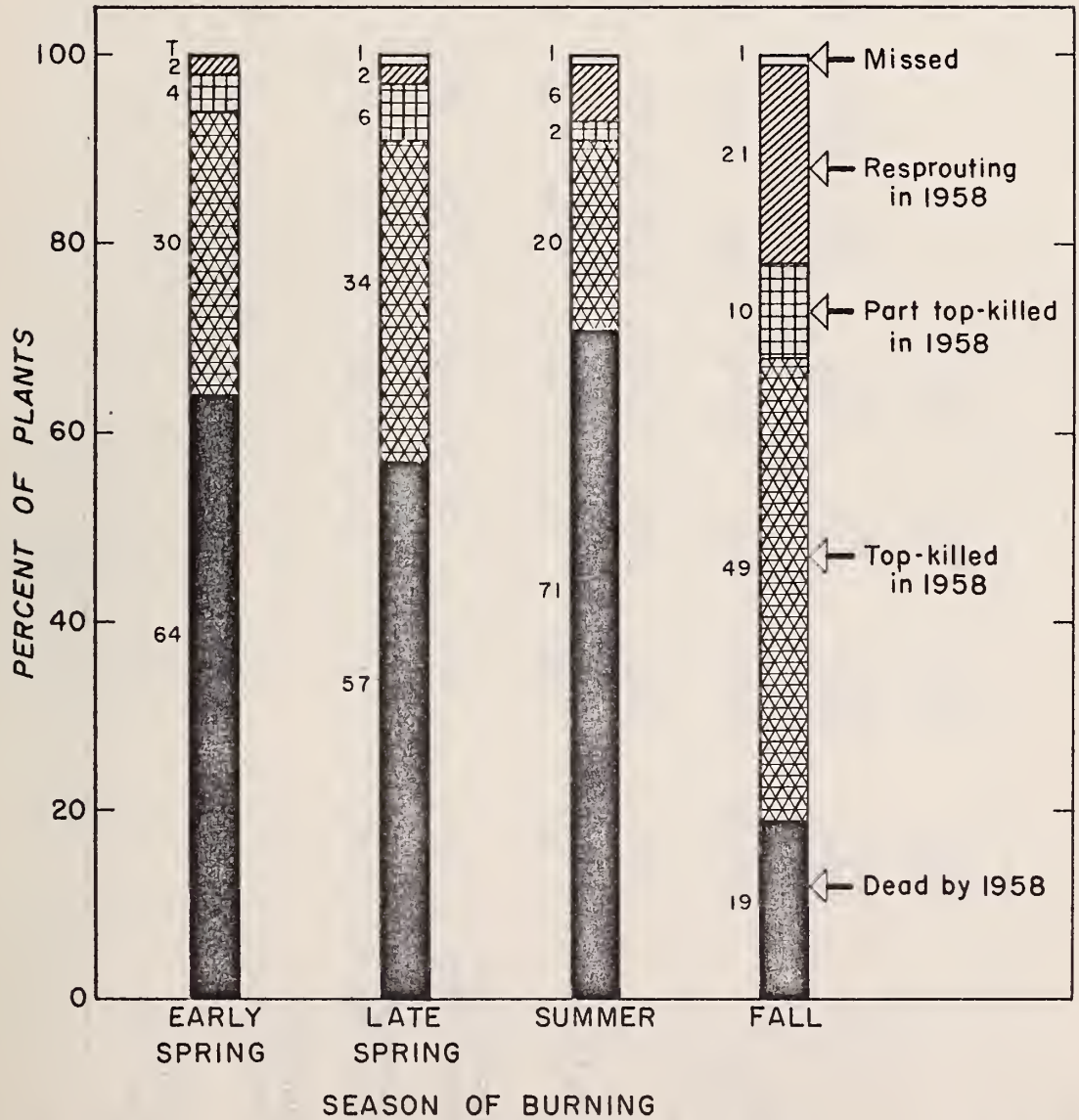

Figure 2.--Average kill of chamise plants from burning, browsing and spraying in plots burned at each of four different seasons.

Table 1.--Survival of chamise plants on plots burned in early spring 1957. Counts made August 1958

Item	Plot Number								Average
	1	2	10	14	8	16	9	17	
Date brush crushed	March 1957	March 1957	March 1957	March 1957	--	--	--	March 1957	--
Years of spraying	1957 1958	1957 1958	1957 1958	1957 1958	1957 1958	1957 1958	-- 1958	-- 1958	-- --
Degree of deer browsing in 1957	Extreme	Extreme	Mod.	Heavy	Mod.	Heavy	Light	Heavy	--
Number of plants per acre	1,725	1,250	3,750	2,325	3,350	2,975	2,650	4,100	2,766
Percent of plants dead by 1958	96	84	44	70	48	66	69	34	64
Percent of plants completely topkilled 1958	4	9	54	19	45	31	28	46	30
Percent of plants partially topkilled 1958	0	7	1	8	3	3	2	17	4
Percent of plants topkilled but resprouting in 1958	0	0	1	2	4	0	1	3	2
Percent of plants missed by spray 1958	0	0	0	1	0	0	0	0	T

Table 2.--Survival of chamise plants on plots burned in late spring 1957. Counts made August 1958

Item	Plot number			Average
	4	11	12	
Date of brush crushing	Oct. 1956	--	March 1957	--
Year of spraying	1958	1958	1958	--
Degree of deer browsing in 1957	Heavy	Heavy	Mod.	--
Number of plants per acre	3,175	3,075	3,300	3,183
Percent of plants dead by 1958	71	62	38	57
Percent of plants completely top-killed in 1958	24	25	52	34
Percent of plants partially top-killed in 1958	2	12	4	6
Percent of plants topkilled but resprouting in 1958	3	0	5	2
Percent of plants missed by spray in 1958	0	1	1	1

Spraying in June 1958 killed an average of 79 percent of the chamise plants alive at that time. An average of 286 plants per acre was still alive in August 1958, but they were not vigorous and probably almost all would die before 1960. They were being closely browsed by deer.

SUMMER BURNING

On the two plots burned August 27, 1957 (table 3), an average of 71 percent of the chamise plants was killed by the hot fires. The spray in June 1958 topkilled most of the plants that survived the fire. Kill in 1958 probably was somewhat reduced because of uneven spray coverage on one plot. An average of 285 plants per acre was still alive in August 1958. The plants were not vigorous and were being heavily browsed. Most of them should die by 1960.

LATE-FALL BURNING

Burning after the first fall rains when ground fuel was moist and weather unfavorable gave much less intense fires than at other seasons, and fire killed fewer chamise plants. Mortality from burning was 11 percent on the plot burned in 1956 and averaged 19 percent on those burned in 1957 (table 4).

Broadcast spraying gave less certain results on the plots burned in October than on plots burned at other seasons. On plot 6, burned October 1956 and sprayed June 1957, the sprouts on almost all plants soon died back, but most of the plants resprouted. Deer grazed heavily on the new sprouts but not closely enough to kill the plants. In September and October many of the plants died from delayed 2,4-D action, but mortality by 1958 was only 58 percent. Apparently this plot was sprayed too early in 1957, which had an unusually late spring growing season. Excellent control was obtained from the second spraying in 1958.

On the three plots burned in October 1957 the degree of resprouting was higher than on the plots burned earlier in the season, and many plants were only partially topkilled. An average of 1,200 chamise plants per acre was still alive in August 1958, but vigor was low and dying probably would continue. The need for another broadcast spraying could not be judged definitely.

Chamise seedlings, which were eliminated by spraying on all plots regardless of burning date, were exceptionally numerous on the October-burned plots. After all seedlings that emerged on plot 6 in 1957 had been killed, another dense stand germinated in 1958 and was killed by the second spraying.

Table 3.--Survival of chamise plants on plots burned in summer 1957. Counts made August 1958

Item	Plot number		Average
	5	7	
Date of brush crushing	Oct. 1956	June 1957	--
Years of spraying	1958	1958	--
Degree of deer browsing in 1957	Light	Light	--
Number of plants per acre in 1958	4,250	2,075	3,163
Percent of plants dead by 1958	65	77	71
Percent of plants completely top-killed in 1958	26	13	20
Percent of plants partially top-killed in 1958	4	0	2
Percent of plants topkilled but re-sprouting in 1958	3	9	6
Percent of plants missed by spray in 1958	2	1	1

Table 4.--Survival of chamise plants on plot 6 burned in October 1956 and three plots burned in October 1957. Counts made in August 1958

Item	Plot number				Average 1/
	6	3	13	15	
Date of brush crushing	Oct. 1956	Oct. 1956	June 1957	June 1957	--
Years of spraying	1957 1958	1958	1958	1958	--
Degree of deer browsing in 1957	Heavy	--	--	--	--
Number of plants per acre in 1958	3,675	2,425	3,725	5,100	3,750
Percent of plants dead by 1958	58	27	11	19	19
Percent of plants completely top-killed in 1958	37	43	45	60	49
Percent of plants partially top-killed in 1958	2	22	2	6	10
Percent of plants topkilled but re-sprouting in 1958	3	7	41	15	21
Percent of plants missed by spray in 1958	0	1	1	0	1

1/ Based on the 3 plots burned in 1957.

APPLICATION OF RESULTS

We conclude that spring is the best season for burning chamise on areas to be converted to grass. If the brush is dense and is prepared for burning by crushing with a bulldozer, the spring season allows considerable latitude in selecting safe weather conditions and burning techniques to get a clean burn without danger of serious escape of the fire. In contrast, selecting safe weather conditions is extremely difficult during the summer and early fall; surrounding brush fuel is dry, and any escape may develop into a disastrous wildfire. A controlled burn usually has to be scheduled and rescheduled several times before the proper conditions are found to permit safe summer burning. Because of this inefficiency and because of the wildfire hazard, summer burning in dense brushfields is not recommended. Late-fall burning, when fuels are moist and weather cool, also is difficult to schedule because of the uncertain occurrence of rain at that time.

Early-spring burning has the advantage of allowing several weeks in which proper burning conditions can be selected. On the other hand, early-spring burning poses some problems in planning and carrying out follow-up broadcast chemical spraying. For example, after an April burn, the decision to spray must wait upon observations that cannot be made until June. Spraying will be needed if deer browsing is not keeping the chamise plants down to a small size or if numerous plants of yerba santa or other rapid growing species are present. Spraying can be delayed until the next spring if deer are keeping all of the sprouts well grazed, particularly under extreme use that may kill the plants without spraying. So, one broadcast spray application may kill most of the chamise sprouts on early spring burns, but more often two applications will be necessary.

Late-spring burning must be fitted into a short season, but it simplifies planning of follow-up spraying. The spraying can be delayed until the next spring because the plants produce a limited amount of sprouts the first year. In this test a single chemical application at a moderate rate the next spring after burning was adequate for good kill of sprouts. Late-spring burning of crushed brush has a further advantage in that control of the fire is favored by the high fuel moisture content of the surrounding brush.

Follow-up control of chamise sprouts by chemical spraying after late-fall burning in this test did not give positive results with one application. The plot burned in 1956 required two broadcast applications and the plots burned in 1957 may also need the second spraying.

This test indicates that late-spring burning of chamise is a good practice that gives the best chance for control of chamise sprouts with one broadcast chemical application. Either early-spring or late-fall burning is suitable from the fire safety angle, but each presents problems in planning the follow-up broadcast chemical spraying.